

## **Theory of Inventive Problem Solving (TRIZ) Case Study**

### **Durango, Colorado – Public Transportation**

### **January 2016**

#### Methodology

We want to use rigorous, scientific, statistically-oriented engineering methods toward improving environmental, social, and economic outcomes. The specific scientific method to be applied in this workshop is called “TRIZ” (pronounced “trees”). This is a Russian acronym which stands for “The Theory of Inventive Problem Solving\*.” Unlike many systems improvement methods that work toward incremental improvement from current state, TRIZ starts with an “Ideal Future State” and then considers real-world constraints to work back to a best case solution to the problem. As an innovation methodology the purpose is to think outside the box and, through the steps of the method, come up with heretofore unidentified, and possibly unexpected, solutions. This method is regularly used by NASA, Ford, Boeing, IBM, and many others\*\*. It is a rigorously structured approach to innovation. And at Sherpa, Inc. we have taken this engineering-oriented method and applied it toward sustainability and social responsibility opportunities.

#### Part I: Choosing the Problem

The goal of the exercise is to find innovation solutions to provide free-ride transportation via the Trolley system within the city of Durango. Bypasses to this goal include no public transportation system available or public transportation at a cost to the rider. Comparisons can be made with other free-ride public transportation systems in mountain towns. Comparison cities are: Boon, NC, Mammoth Lakes, CA, Vail, CO, and Wilmington, VT. Solutions presented or considered by comparison cities include:

- Paid advertising on the bus
- Automated transportation (light rail)
- Commercial sponsorship
- Partial pay cards
- Costs covered by university fees (where heavy ridership by students)
- Employer paid (where heavy ridership by specific employers)

Part I conclusions lead to not pursuing the bypass. Other, similar communities have solved the same problem without bypass. A Durango solution should be possible. Similar community solutions should be kept in mind through the innovation process.

#### Part II: Define the Problem More Precisely

The TRIZ methodology has us vary size, time, and cost operators to seek the boundaries of innovation potentials. Size in this problem is represented by the physical dimensions of the route, the determination to the terminal points of the Trolley route. Time is represented by the rider wait duration for pick up. And cost is represented by the cost to the rider. Each of these dimensions should be independently varied between approaching zero and approaching infinity.

- As size approaches zero: there is no service, or extremely short routes, such as only extending to Main Ave. in the downtown area.

- As size approaches infinity: there would be transportation service at every citizens door
- As pick up time approaches zero: transport arrives exactly when needed
- As pick up time approaches infinity: rider is required to walk to widely distributed points or wait for rarely scheduled rides
- As rider cost approaches zero: free ride to all, thus extremely low cost to operate
- As rider cost approaches infinity: luxury/limousine service with custom, personal service.

Considering these boundaries we can write a system description. ***Given a system consisting of a trolley with free fare, people in the city of Durango are transported from point A to point B.***

Now, we define the elements in this system.

Types of Elements	Elements
Easy to change elements	Fare, points A and points B
Difficult to change elements	Trolley equipment, location of people

### Part III: Analytical Stage

The third step in the TRIZ method has us state the ***Ideal Final Result***. This is a statement of the ideal solution without regard to any physical, social, or economic considerations. In this case study the ideal final result happens when every person instantly moves from any desired starting point to any desired end point, instantaneously. The Ideal Final Result for this system would be a teleportation system. Wouldn't that be nice!? Unlike other problem solving methods, TRIZ starts with an unrealistic ideal (teleportation) and then compromises back to a best solution; other problem solving methods start with the current state and attempt to incrementally improve forward. Obviously, the laws of physics require transportation to move through a route at a speed and frequency.

### Part IV: Preliminary Analysis of the Arrived-at Concepts

Next we determine the system factors that contribute to performance contradictions. There are 3 factors of consideration: route, time, and cost. The following chart shows some preliminary solutions as these factors are varied.

Factor			
Route (inverse terminus distance)	decrease	decrease	Increase
Time (rider wait time)	decrease	increase	decrease
Cost (rider cost)	increase	decrease	decrease
Directional Solutions	Personal limousine/uber-style transportation	Very few trolleys on the road, or great distance between stops	Small zone of coverage

In the TRIZ contradiction matrix if cost is getting better then route and time is getting worse. Using the TRIZ40.com matrix the following solution category and potential solutions are noted.

TRIZ 40 Solution Category	Possible Solutions
Segmentation	<ul style="list-style-type: none"> <li>• Differing routes in differing times of year</li> <li>• Differing routes in different areas (flexible/not static routes)</li> <li>• Different costs for different routes (passes for some routes (ex: FLC) and not others</li> <li>• Decrease segmentation – only one main trunk line</li> </ul>
The Other Way Around	<ul style="list-style-type: none"> <li>• Custom, pseudo-custom service – use an app to call the trolley to a stop, otherwise the trolley does not go to the stop/terminus, thus move the place not the people</li> <li>• Employers pay for employee passes</li> </ul>
Partial/excessive Action	<ul style="list-style-type: none"> <li>• Use trolleys for another use, such a mail, courier service, freight or school buses</li> <li>• Each trolley is “owned” by a sponsor</li> </ul>
Discarding/Recovering	<ul style="list-style-type: none"> <li>• Move some public transportation to bicycle rental such as in major cities: Washington, D.C., Paris, Seattle, etc.</li> <li>• Uber, public transportation only when you need it</li> </ul>
Local Quality	<ul style="list-style-type: none"> <li>• Use trolleys for another use, such a mail, courier service, freight or school buses</li> <li>• Citizens don’t pay/receive a pass card (like a library card) but tourists/visitors pay very high cost</li> </ul>
Intermediary	<ul style="list-style-type: none"> <li>• Trolleys only cover local/small zone, but connect to other solutions: uber, taxi, bikes, ride n share lots</li> <li>• Employers pay for employee passes</li> <li>• Employee passes sponsored by chamber of commerce or some other employment-interested intermediary/sponsor</li> </ul>
Parameter Change	<ul style="list-style-type: none"> <li>• Differing routes in differing times of year</li> <li>• Differing routes in different areas (flexible/not static routes)</li> <li>• Cost comes from other than rider: advertising, university or corporate sponsorship, buzz bus, etc.</li> </ul>

#### Author

Holly Duckworth, Ph.D. is a founding partner of Sherpa, Inc.: A Benefit Company (sherpabcorp.com). We are a sustainability consulting company operating as a benefit corporation. Sherpa, Inc. partners have worked with many large, global organizations such as: GE, Wal-Mart, Verizon, Disney, TRW, and others. Holly has a B.S. in Mechanical Engineering, an M.S. in Management, and a Ph.D. in Psychology. She is a citizen of Durango. Her participation in this workshop was a personal and pro bono contribution back to her beloved home town.

\*Altshuller, G. (1999). *The innovation algorithm: TRIZ, systemic innovation and technical creativity*. Technical Innovation Center: Worcester, MA

\*\* Jana, R. (May 30, 2006). The world according to TRIZ. Bloomberg Business. Retrieved from: <http://www.bloomberg.com/bw/stories/2006-05-30/the-world-according-to-triz>